CHAPTER 31

MATHEMATICS

Doctoral Theses

01. AGRAWAL (Neha)
Synchronization of Integer and Fractional Order Chaotic Systems.
Supervisors: Dr. D. Khattar and Prof. Ayub Khan
Th 24567

Abstract
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In this thesis titled "Synchronization of Integer and Fractional Order Chaotic Systems", the focus has been on synchronizing the integer and fractional order chaotic and hyperchaotic systems by using active control technique. Two new systems have been introduced that are chaotic in nature and the concepts of dual combination- combination multiswitching synchronization DCCMS and dual combination - combination anti synchronization DCCAS are extended to fractional order systems. Various synchronization methods which includes complete synchronization, anti synchronization, hybrid synchronization and hybrid projective synchronization have been employed to synchronize non - identical integer and fractional order chaotic systems. Suitable controllers have been designed using the stability criteria for the integer and fractional order systems, to achieve the desired synchronization between the drive and response systems. Numerical Simulations were accomplished and graphical representations had been depicted to show the effectiveness of the numerical results using MATLAB. Two new chaotic systems have been introduced and some of their properties had been investigated. The novel structures are then synchronized with the chaotic systems already present in literature. Two new schemes of DCCMS and DCCAS for synchronizing multiple drive-response systems of fractional order had been proposed. The proposed schemes are then applied to eight fractional order chaotic systems. Some special cases of dual synchronization, dual combination synchronization, combination - combination synchronization had been discussed.

Contents

1. Introduction 2. Complete, anti and hybrid synchronization of two non-identical chaotic systems via active control 3. Synchronization between two non-identical fractional order hyper chaotic systems 4. Hybrid projective synchronization between the fractional order systems of different dimensions 5. Synchronization of novel between order chaotic system via active control 6. Dual combination multiswitching and anti synchronization of eight fractional order chaotic systems. Index.

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02. ANTONY A. (Janson)
Tensor Products of Operator Spaces: Their Inductive and Projective Limits.
Supervisors: Dr. Ranjana Jain and Prof. Ajay Kumar
Th 24568

Abstract
(Not Verified)

The theory of operator spaces has been one of the important topics in functional analysis since the last three decades, which showed rapid growth during the period. Even the tensor products in the categories have been extensively studied. The construction of the operator space projective, Haagerup, and Schur tensor products were generalized to form the λ-tensor product. The construction was further improved to define analogous tensor products of operator systems. The main aim of the thesis is to investigate further properties of the λ-tensor product, and to more generalize the constructions. The thesis begins with exploring algebraic properties of the λ-tensor product of C*-algebras, including a discussion of the structure of closed ideals in it. Suitable conditions that can be imposed on λ which would guarantee desirable properties of the tensor product such as projectivity, injectivity etc. and the injectivity of the canonical map into the Banach space injective tensor product are included. Sufficient conditions are introduced which guarantees that inductive limit commute with the λ-tensor product. Certain other cases are separately considered. A natural embedding concerning the bidual of an inductive limit of tensor products is also discussed. A proof for the commutativity of inductive limit with the λ-tensor product of operator systems is given. Natural analogue of the λ-tensor product of local operator spaces is defined, and its commutativity with the projective limits is shown. Several properties of λ-tensor product of local operator spaces and pro-C*-algebras are explored. In the last chapter of the thesis, a generalization of completely bounded maps is introduced, and their basic properties are explored. In a similar way, a bilinear analogue of the jointly completely bounded and matricially completely bounded bilinear maps is introduced, and a tensor product associated with these bilinear maps is studied.

Contents

1. Introduction. 2. The λ-tensor product of operator spaces 3. Inductive limit of operator spaces 4. Projective limit of operator spaces 5. Variations of complete boundedness. Bibliography. Index. List of symbols.

03. ARORA (Monika)
Analysis of Photogravitational Restricted Four-Body Problem Under the Effect of Oblateness, Variables Mass, Coriolis and Centrifugal Forces.
Supervisor: Dr. Rajiv Aggarwal
Th 24569

Abstract
(Verified)

Celestial Mechanics is the branch of the dynamical astronomy which deals with the motion of the solar system bodies on the basis of laws of gravitation. The thesis explores the motion of an infinitesimal mass in the restricted-four body problem, when all the three primaries are set in Lagrange equilateral triangle configuration.
Chapter 1 contains the basic results and methodology to be used in the subsequent chapters. Chapter 2 investigates the model of the restricted four-body problem under the effect of oblateness of all the primaries. We have shown how the oblateness parameter influences the existence, location, the number of libration points, regions of motion and the Newton-Raphson basins of attraction. Chapter 3 deals with the analysis of the restricted four-body problem under the combined effect of the Coriolis and centrifugal forces. The study reveals the effect of the Coriolis and centrifugal

force parameters on the existence, location of the libration points, the regions of possible motion of the infinitesimal mass and the Newton Raphson basins of attraction. Chapter 4 investigates the model of the restricted four-body problem when the mass of the test particle is varying with time, which follows Jeans' law(1928). We have shown the effect of the mass parameter and the parameter occurring in the Jeans' law on the existence and locations of the libration points in the model. In Chapter 5, we have studied the combined effect of variable mass and the radiation pressure due to the primaries in the model of the restricted four-body problem. We have shown how the radiation parameters affect the linear stability of the Lagrange equilateral triangle configuration. We have drawn the zero velocity curves of the problem and the Newton-Raphson basins of attraction using the Newton-Raphson iterative scheme.

Contents

1. Introduction 2. Exploring the fractal basins of convergence in the restricted four-body problem with oblateness 3. Existence and location points in the restricted four body problem with the effect of small perturbations in the coriolis and centrifugal forces 4. The basins of attraction in the planer restricted four body problem with variable mass 5. Exploring the photogravitational restricted four body problems with variable mass. Bibliography.

04. BAJARGAAN (Ruchi)
Shock Waves in Rotating or Non-Rotating Gases under Radiation Field.
Supervisor: Dr. Arvind Patel
Th 24582

Abstract
(Not Verified)

The thesis entitled "Shock Waves in Rotating or Non-rotating Gases under Radiation Field" mainly deals with the study of shock waves in rotating or non-rotating, ideal or dusty gas under the radiation effect in presence or absence of gravitation and magnetic field. The thesis is divided into six chapters. Chapter 1 gives a brief account of some concepts and results concerning the study of shock waves. In Chapter 2, we investigated one-dimensional unsteady adiabatic flow behind a shock wave propagating in a rotating, axisymmetric perfect gas under the presence of thermal radiation. The effects of variation of the radiation parameter, the ambient density index and the ambient azimuthal/axial velocity index on the flow-field are studied. In Chapter 3, similarity solutions have been obtained for the propagation of a shock wave driven by a piston moving with time according to an exponential law in a perfect gas with azimuthal magnetic field, heat flux. The effects of the variation of the strength of ambient magnetic field, heat transfer parameters and other parameters on the flow-field are studied. In Chapter 4, we studied the propagation of a cylindrical shock wave in a self-gravitating, rotating axisymmetric perfect gas under monochromatic radiation and variable ambient density, azimuthal and axial components of fluid velocities. In Chapter 5, we studied one dimensional unsteady adiabatic flow behind an exponential shock wave propagating in a self-gravitating, rotating, axisymmetric dusty gas with heat conduction and radiation heat flux under exponentially varying azimuthal and axial fluid velocities in the ambient gas. In Chapter 6, we obtained the approximate solution for the system of conservation laws for mass, momentum and energy governing the motion of one dimensional unsteady adiabatic flow of a perfect gas in planar, cylindrical and spherical symmetry by applying the homotopy analysis method (HAM) under the variable initial conditions.

Contents

1. Introduction 2. Shock wave in an axisymmetric rotating perfect gas with variable density under thermal radiation 3. Magnetogasdynamic exponential shock wave in a perfect gas with variable 4. Cylindrical shock wave in a self-gravitatiing, rotating axisymmetric gas with variable density under the effect of monochromatic radiation 5. Exponential shock wave in a self-gravitating, rotating axixymmetric dusty 6. Study of a one-dimensional unsteady adiabatic gas flow by homotopy analysis method. References.

05. BISWAS (Jayanta)
Strong and Weak Forms of Continuous Functions on Ideal Topological Spaces.
Supervisor: Dr. A. R. Prasannan
Th 24576

Abstract
(Not Verified)

In this thesis we applied the framework of ideal topological space on an important class of sets: zero set. The study of topological ideal was initiated by Kuratowski [62] and expanded further by Vaidynathswamy [98]. Most of the work in this theis is motivated from Hayashi's work in [37]. In [37], author emphasized on two major objectives. The application of _-topology in the generalisation of Alexandroff's one point compactification. The study of the relations between the _-topology and the original topology whena space is _-dense-in-itself. In 1990, Jankovic and Hamlett [39] proved that the condition [87] and X = X* (a space is *-dense-in-itself, [37]) are equivalent and also introduced the term ideal topological space (X; T; I). Earlier the condition in the ideal topological space (X; T; I) used to be known as codense Ideal by Ganster et.al. [23] and Newcomb [76] and T* -boundary by Hamlett in [32]. In 1999, Dontchev [22] calls such space as "Hayashi- Samuels" spaces. In 2007, Mukherjee et.al. extended the work of Hayashi and studied certain extension problems via ideals and termed it as ideal extension. It is shown that two compactifications of a Tychonoff space, with identical strength systems, are equivalent. Despite all of this, studies in this direction are far from complete. Particularly, with regard to notions like functionally I-Hausdorff, functionally I-regular, functionally I-normal etc. These developments motivate one to provide a theoretical background for the generalized zero sets in the framework of Ideal Topological space. In present thesis we attempt to bridge the existing gaps in the study of zero sets and ideal topological space by investigating generalized structures related to I-open sets, _-open sets and zero-I-sets. We also investigated the space of CI(X;R) of real valued I-continuous functions.

Contents

1. Introduction 2. Generalization of z-open sets by using hayashi-samuels space 3. Some strong and weak form of z-continuity via ideal 4. On strong form of continuous functions and δ-$\tilde{I}$ continuous functions 5. A class of mapping between R_2-super-continuous function and R_2-super continuous functions 6. Functions between R-$\tilde{I}$-continuous functions and strong θ-$\tilde{I}$-continuous functions. Bibliography.

06. BUSSI (Khushboo)
Cryptographic Hash Functions: Design & Analysis.
Supervisors: Prof. B. K. Dass and Dr. Dhananjay Dey
Th 24571

Abstract
(Verified)

In this thesis, we propose some cryptographic hash functions which are better than their existing version with respect to security or efficiency or both. They overcome all the weaknesses or attacks mounted on the initial designs. They can withstand today's security requirements and cruciality of the designing criteria. We propose few hash functions viz., MGR, Neeva, Kupy-Neev hash functions and their applications in real world. In Chapter 1, we give an introduction of cryptography, its evolution, its security parameters and cryptanalysis and a detailed survey on cryptographic hash functions. In Chapter 2, we propose MGR (Modified GOST-R 34.11-2012) hash function which is an improved version of GOST-R. GOST-R was standardised as Russian standard hash function in 2012. In MGR, the compression function has been changed and the mode of operations of the compression function is based on double-pipe construction. This helps in getting rid of the mentioned weaknesses and seems to make MGR less vulnerable to existing attacks. Neeva is a lightweight hash function which is proposed basically for RFID technology. It is described in Chapter 3. Its design is based on sponge construction which is quite secure. A detailed analysis of this function has been included in this chapter. Kupy-Neev hash function, also called KN hash is modification in Kupyna whose underlying compression function is inspired by Neeva hash function. Kupyna has been chosen as standard cryptographic hash function for Ukrain in 2015. Many attacks were mounted on Kupyna. Hence, we propose Kupy-Neev hash function in Chapter 4 whose underlying compression function has totally changed. It is more secured than Kupyna and can act as a better alternative. In this thesis, we have introduced the mentioned three hash functions and their heuristic security proof. We also show few more real-world applications of those hash functions and its future extension.

Contents

1. Introduction 2. MGR hash function 3. Neeva: A lightweight hash function 4. Kupy-neev hash function 5. Application of hash functions. Conclusion. References.

07. CHAUHAN (Manish)
Wavelets and Multiwavelets in Sobolev Spaces.
Supervisor: Dr. Raj Kumar
Th 24575

Contents

1. Introduction 2.Subordinations for caratheodory functions 3.Srarlike functions associated with lune and leaf 4. Convex combination of starlike functions 5.Meromorphic starlike functions with negative coefficients .References and Index.

08. DAS (Pramod Kumar)
Variants of Shadowing and Expansivity for Dynamical Systems on Uniform Spaces.
Supervisor: Prof. Tarun Kumar Das
Th 24572

Abstract
(Not Verified)

The main objective of the present thesis is to discuss dynamical behaviours of systems with variants of shadowing and expansivity on uniform spaces. Chapter 1 is

a brief survey of the basic concepts and results from the classical theory of topological dynamics. In Chapter 2, we define various topological notions including topological shadowing for continuous maps on uniform spaces and prove their equivalence for a surjective uniformly continuous map with topological shadowing on a totally bounded uniform space. In Chapter 3, we introduce a new variant of shadowing called mean ergodic shadowing for continuous maps on compact metric spaces. We study its relation with other variants of shadowing and also with distality and minimlaity. In Chapter 4, we study expansive measures on uniform spaces. We conclude some results analogous to that of expansive homeomorphisms on compact metric spaces. Most importantly, we show that the class of strictly positive measures cannot be expansive for Denjoy homeomorphisms on the unit circle. We study relations among shadowing, local weak specification, peridoc shadowing and strong periodic shadowing of a homeomorphism in the presence of measure expansivity or strong measure expansivity. In Chapter 5, we introduce notions of topological stability, μ-topological stability, shadowing, μ-shadowing, persistence, μ-persistence for finitely generated group actions on uniform spaces and prove that an expansive (μ-expansive) action with either shadowing or persistence (μ-shadowing or μ-persistence) is topologically stable. In Chapter 6, we introduce and investigate expansivity, persistence and topological stability for measures with respect to non-autonomous bi-measurable maps. We extend Walters stability theorem to measures satisfying expansivity and shadowing with respect to non-autonomous homeomorphisms on Mandelkern locally compact metric spaces.

Contents

1. Introduction 2. Various types of shadowing on uniform spaces 3. Mean types shadowing 4. Expansivity and measures on uniform spaces 5. Stables group actions on uniform spaces 6. Expansive and stable measures in nin-autonomous systems. References.

09. JAIN (Mukta)
Generalized Multiplication and Composition Operators on Weighted Hardy Spaces.
Supervisor: Dr. Gopal Datt
Th 24566

Abstract
(Verified)

The study of multiplication and composition operators play an important role in the study of operators on Hilbert spaces and are the prominent examples in the different areas of the mathematical sceinces. The class of multiplication and composition operators together derive an important class of operators called weighted composition operators. These operators are used in the study of dynamical systems, the theory of C*-algebras and in the theory of differential equations. We study multiplication, composition and weighted composition operators over weighted Hardy spaces associated with the derivative of the functions. With the importance of differential operators, an experiment is done by connecting the theory of multiplication operators with the derivative of the functions and the study is lifted to generalized multiplication operators. The wide appearance of these operators gives a motivation to further extend it to kth-order generalized multiplication operators on weighted Hardy spaces. We study about the boundedness and compactness of these operators along with the description of some spectral properties. We find the characterization for the kth-order generalized multiplication operators to be normal. Subsequentely, while studying generalized multiplication operators of higher order, we came across with some of the unbounded operators. We discuss the closedness

and densely defined nature of these operators. Further, by introducing the generalized composition operators of higher order, we study the non-normal properties of these operators alongwith its Hilbert-Schmidt's behaviour. We identify certain symbols so that the induced kth-order weighted generalized composition operators are co-isometry or partial isometry. We obtain a necessary condition for the commutativity of composition operators and generalized multiplication operators on weighted Hardy spaces. The properties of the self maps on D, the open unit disc, and complex valued mapping on D are obtained when the induced weighted generalized composition opertors of higher order on weighted Hardy spaces is Fredholm.

Contents

1. Introduction 2. Generalized multiplication operators 3. Generalized composition operators 4. Weighted generalized composition operators 5. Fredholm weighted generalized composition operators 6. Unanswered problems. References.

10. KAPOOR (Muskan nee Manju Kalra)
Optimality and Higher-Order Duality in Certain Vector Optimization Problems.
Supervisors: Dr. S. K. Suneja and Prof. C. S. Lalitha
Th 24580

Abstract
(Verified)

The purpose of the thesis is to study various optimality conditions and duality aspects for certain vector optimization problems. The thesis is divided into five chapters. Chapter 1 is introductory. Chapter 2 is based on the study of optimality conditions and duality results for vector optimization problem over cones. In Section 2.1, we study optimality and duality results using the notion of rho-cone convexity and its generalizations. In Section 2.2, we prove optimality and duality results using classes of cone vector G-invex functions. Chapter 3 is devoted to the study of higher-order duality results for vector optimization problems over cones. In Section 3.1, we define a new class of higher-order generalized type I functions over cones and establish higher-order Mond–Weir type duality results for problem containing support functions. In Section 3.2, we derive higher-order optimality conditions and higher-order Schaible type duality results for a fractional vector optimization problem over cones. Chapter 4 is devoted to the study of duality results for a pair of Mond–Weir type second-order multiobjective symmetric dual programs over arbitrary cones. In Section 4.1, we introduce the notions of second-order rho-cone invex function and its generalizations and study their interrelations. In Section 4.2, we consider a pair of second-order symmmetric dual problems over cones and study duality results using the functions defined in Section 4.1. Chapter 5 deals with the notion of cone-continuity property (CCP) in vector optimization. In Section 5.1, we establish that this property is a strict regularity condition for efficient solutions and is the weakest condition which ensures that weak approximate KKT implies weak KKT conditions. In Section 5.2, we establish that the CCP is a strict constraint qualification while considering weak and proper efficient solutions.

Contents

1. Introduction 2. Multiresolution analysis and construction of wavelets 3. Multiresolution analysis with multiplicity r and multiwavelets 4. Wavelets packets and multiwavelet packets in $H^s(R^d)$ 5. Wavelets frames and wavelet frame packets in $H^s(R^d)$ 6. Application of wavelets in weighted sobolov space. Index.

11. KAUR (Charanpreet)
Restricted Three and Four-Body Problems with Quasi-Homogeneous Manev-Type Protential.
Supervisor: Dr. Binay Kumar Sharma
Th 24581

Abstract
(Not Verified)

The present thesis is written in the area of Celestial mechanics. The research work is devoted to the study of Restricted three and four-body problems with quasi-homogeneous Manev-type potential The organization of the thesis is as follows: Chapter 1 gives the brief survey of the history and basic results required for the remaining chapters. To reveal the fractal basins of convergence by using the multivariate version of the Newton-Raphson iterative scheme corresponding to the coplanar libration points in the Copenhagen problem is the central theme of Chapter 2. The parametric evolution of the libration points and their stability is explained further. The evolution of the Newton-Raphson basins of convergence, associated with the libration points are displayed. Chapter 3 is composed of the analysis of Copenhagen problem with a repulsive quasi homogeneous Manev-type potential within the frame of variable mass. The parametric evolution of the positions of libration points are unveiled and the effects of the involved parameters on the regions of possible motion are discussed. The primary focus of Chapter 4 is the basins of convergence in the collinear restricted four-body problem with repulsive Manev-potential. The parametric evolution of the position as well as of the stability of the equilibrium points is presented. Then, the main numerical results, regarding the evolution of the Newton-Raphson basins of convergence are analysed. Moreover, the evolution of the basin entropy of the configuration plane are monitored. Chapter 5 consists of the existence of liberation points in the spatial collinear restricted four-body problem with repulsive Manev-potential and variable mass. Also, the Hill's regions as a function of the parameters using the Jacobi integral is the primary goal of this chapter. Based on the results and discussions, conclusions drawn are systematically presented at the end of each chapter.

Contents

1. Introduction 2.Factal basins of convergence of libration points in the planner Copenhagen problem with a repulsive quasi-homogeneous Manev-type potential 3. The analysis of Copenhagen problem with a repulsive quasi-homogenous manev-type potential within the frame of variable mass 4. Basins of convergence in the collinear restricted four-body problems with repulsive manev potential 5. On the existence of libration points in the spatial collinear restricted four-body problems within frame of repulsive manev potential and variable mass. Bibliography.

12. MANTRY (Poonam)
Frame Based Reconstruction of Signals in Multirate Digital Signal Processing.
Supervisors: Dr. Shiv Kumar Kaushik
Th 24573

Abstract
(Not Verified)

The present thesis entitled Frame Based Reconstruction of Signals in Multirate Digital Signal Processing, aims to study the reconstruction of digital signals in multirate digital signal processing. The thesis is divided into five chapters starting

from Chapter 1 to Chapter 5 followed by References at the end of the thesis. Chapter 1 gives a brief historical background motivating the present study, basic concepts and some related known results which are required in the subsequent chapters. Chapter 2 to Chapter 5 constitute the main body of the thesis, the contents of which have been published/accepted/communicated for publication in [1], [2], [3], [4]. Chapter 2 focuses on the discrete time Weyl- Heisenberg frames and Balian - Low Theorem in discrete space . Chapter 3 focuses on the study of multidimensional discrete time Zak transform and its role in the study of multidimensional discrete time Weyl-Heisenberg frames. In Chapter 4 and Chapter 5, we shall study Discrete time Wavelet frames in sequence space and its multidimensional version. Chapter 1 consists of three sections. Section 1.1 gives a brief introduction explaining the motivation behind our work presented in the thesis. Section 1.2 is based on giving historical background where brief survey related to frames in Hilbert spaces, Zak Transform, Weyl-Heisenberg frames and Fourier Transform is given. Finally, in Section 1.3, basic definitions and some related known results from functional analysis, theory of frames, Gabor theory and theory of uncertainty principle required throughout the thesis, have been collected for the sake of completeness. The details and proofs of the results in this chapter have been omitted but proper references for them have been given. In Chapter 2, we focus on the reconstruction of digital signals in multirate digital signal processing. This chapter is divided into two sections. In Section 2.1, we study the discrete time Weyl- Heisenberg (DTWH) systems for oversampling schemes and decribe the frame operator of DTWH frames as the composition of sampling operator and interpolation operator. Using discrete time Zak transform (DTZT), we characterize the dual discrete time Weyl-Heisenberg tight (DDTWHT) frames, DTWH frames and tight DTWH frames based on oversampling schemes. We also discuss the applications of DTWH frames to the reconstruction of Weyl-Heisenberg systems in the periodic space Finally, in Section 2.2, Balian-Low theorem (BLT) for orthonormal basis formed by DTWH systems is given and a weak Balian-Low theorem for exact DTWH frames in is also given. The results of this chapter are published in [1]. In Chapter 3, we introduce multivariate discrete time Weyl- Heisenberg (MDTWH) system in multidimensional sequence space . This chapter is divided into two sections. In Section 3.1, we define multidimensionaldiscrete time Zak transform (MDTZT), which plays a significant role in the analysis of multivariate discrete time Weyl-Heisenberg (MDTWH) frames. We discuss various properties of MDTZT and give various relationships between multidimensional discrete time Fourier transform and MDTZT. We also prove that the product of two multidimensional discrete time Zak transforms can be represented by a multidimensional Fourier series. In Section 3.2, we discuss various discrete sampling results of MDTWH systems in oversampling scheme and critical sampling scheme. We show that the frame operator of MDTWH frames is associated with the sampling operator and interpolation operator and using MDTZT, we give various characterizations of MDTWH systems. Further, a necessary and sufficient condition for the existence of MDTWH frames is given and the existence of dual MDTWH frames is established. Finally, we discuss the applications of MDTWH frames to formulate the construction of multivariate Weyl-Heisenberg frames in the periodic space . The results of this chapter are published in [2]. In Chapter 4, using discrete time wavelet frames (DTW frames), we formulate the reconstruction of digital signals in multirate digital signal processing. In Section 4.1, the frame operator of DTW frames is described in terms of the operations of sampling and interpolation operators. By taking a collection of M filters, we construct and characterize dual discrete time wavelet tight frames (DDTWT frames) and discuss a necessary and sufficient condition for the existence of orthonormal basis of weighted exponentials of factor N. In Section 4.2, we give applications of DTW frames to the theory of frames of weighted exponentials of factor N in periodic space Another version of Balian-Low theorem for orthonormal bases of weighted exponentials of factor N in

the space is given in Section 4.3. The results of this chapter are communicated in [3]. Chapter 5 is devoted to the reconstruction of multidimensional digital signals in multirate digital signal processing. In Section 5.1, we prove that the composition of sampling operator and interpolation operator forms the frame operator of multivariate discrete time wavelet system of scale matrix N. By taking a collection of M filters, we give the reconstruction of digital signals via dual multivariate discrete time wavelet tight frames and discuss the existence and construction of multivariate discrete time wavelet Parseval frames in multidimensional sequence space .. In Section 5.2, we discuss the sampling results of multivariate discrete time wavelet system of scale matrix N for critical sampling schemes and a necessary and sufficient condition for the existence of orthonormal basis of scale matrix N is given. Biorthogonal pair of Riesz bases is characterized using dual multivariate discrete time wavelet tight frames. The notions of multivariate Parseval frame of weighted exponentials and dual multivariate tight frame of weighted exponentials of scale matrix N in periodic space are introduced in Section 5.3. We conclude this chapter with the applications of multivariate discrete time wavelet frames in the theory of frames of weighted exponentials of scale matrix N in periodic space which ultimately enhances the theory of the frame of weighted exponentials studied in existing literature. The results of this chapter are communicated in [4]. References [1] K.T. Poumai, S. K. Kaushik and Poonam Mantry, Weyl-Heisenberg Frames and Balian - Low Theorem in `2(Z), J. Math. Phys. 60, 043507 (2019). Impact Factor-1.228 (MR3942147) [2] K.T. Poumai, S. K. Kaushik and Poonam Mantry, Frame Based Reconstruction of Signals in Multirate Implementation, Poincare J. Anal. Appl., Special Issue (ICAM, Delhi), 31-51, 2019(1). [3] K.T. Poumai, S. K. Kaushik and Poonam Mantry, Discrete Time Wavelet Frames and Uncertainty Principle in Critical Sampling, (Communicated). [4] K.T. Poumai, S. K. Kaushik and Poonam Mantry, Reconstruction of Multidimensional Digital Signals (Communicated).

Contents

1. Prerequisites 2. Weyl-heisenberg frame and Balian-low theorem in ℓ^2 (Z) 3. Multivariable weyl-heisenberg frames in ℓ^2 (Z^d) 4. Discrete time wavelet frames in ℓ^2 (Z) 5. Reconstruction of multidimensional digital signals. References.

13. PANDEY (Shashi Kant)
Cryptographic and Combinatorial Characterization of Boolean Functions.
Supervisors: Prof. B. K. Dass and Dr. P. R. Mishra
Th 24570

Abstract
(Verified)

Boolean functions play an important role in designing of a good cryptographic system whether it is a block cipher or a stream cipher. The resistance against the attacks on a cryptosystem may be acquired by tuning various cryptographic parameters for Boolean functions and S-boxes. However searching or constructing a Boolean function having optimal values of cryptographic parameters is a challenging task. In this thesis, we investigate cryptographic properties of known Boolean functions and present construction as well as enumeration of cryptographically significant Boolean functions for different domains. In Chapter 1 a brief introduction of cryptography and Boolean function has been given. It includes mathematical background and the definitions of cryptographic parameters. Chapter 2 contains the cryptographic characterization of multiplexer Boolean function. We study multiplexer Boolean function with respect to various cryptographic parameters, in order to judge its suitability for its use in cryptographic designs. Chapter 3 includes

a generalized construction of bent function over Galois ring. This construction leads to the conclusion that for every even n and prime values of q, a generalized bent function exists from Zqn to Zq . Chapter 4 contains the analysis of cryptographic and combinatorial properties of symmetric Boolean function and generalized symmetric Boolean function. In this we enumerate three types of generalized symmetric Boolean functions and proposed the construction of generalized symmetric and generalized rotational symmetric bent functions on Z32 to Z3 . We proved that a generalized bent function never satisfy the balancedness property. In chapter 5 we derive a set of Diophantine equations from the Walsh transformation of generalized condition which constitute a necessary condition in terms of polynomial Diophantine equations for the existence of generalized bent functions. With help of an example we demonstrate how this condition may be used to ascertain non-existence of generalized bent function and existence of regular bent function.

Contents

1. Introduction 2. Cryptographic properties of multiplexer Boolean function 3. Maiorana McFarland bent function on Galois ring 4. Generalized symmetric and rotational symmetric Boolean function: Count and cryptographic properties 5. On walsh spectrum of cryptographic generalized Boolean function. Conclusion. References. Index.

14. SAGAR (Ravi Kumar)
Restricted Three Body Problem with Differenct Shapes of Primaries.
Supervisor: Dr. Mohd. Arif
Th 24583

Abstract
(Not Verified)

This is the study of two important branches of mathematics. The first part is related to the restricted three body problem (RTBP) of celestial mechanics and the second part extends the chaos theory of nonlinear dynamics with RTBP. Both parts have high importance because they touch some kind of real world problems. In Chapter 1, we give a general introduction about the history and problem of RTBP and also introduce the background of chaos synchronization problem. In Chapter 2, the equations of motion of infinitesimal mass when bigger primary is an uniform circular disk have been derived. The existence of collinear, non-collinear equilibrium points and the zero velocity curve which place restrictions on particle motion are discussed. The stability of the equilibrium points is also investigated. In Chapter 3, the equations of motion of infinitesimal mass when both the primaries are uniform circular disks have been derived. The existence of collinear, non-collinear equilibrium points and zero velocity curve are discussed. The stability of the equilibrium points is also studied. In Chapter 4, the equations of motion when the primaries are moving in a circular orbit around their center of mass in the non-uniform motion have been derived. We discuss the complete synchronization of the problem via active control technique. Numerical simulations have been performed to show the effectiveness of the proposed controllers. In Chapter 5, we have applied the active control technique based on the Lyapunov stability theory and Routh-Hurwitz criteria to study the synchronization behaviour of identical planar magnetic binaries problem, when the primaries are oblate spheroids. Numerical simulations are shown to verify the analytical results.

Contents

1. Introduction 2. Restricted three body problem when one of the primary is an uniform circular disk 3. Restricted three body problem when both the primaries are uniform circular disks 4. Synchronization control of two identical restricted three body problems via active control 5. Synchronization of a planar magnetic binaries problem when the primaries are oblate spheroids.

15. SINGH (Konthoujam Somorjit)
Borsuk-Ulam Type Theorems and Finite Groups Acting Freely on Spaces of Cohomology Type (a,b).
Supervisors: Prof. Tej B. Singh and Dr. Hemant Kumar Singh
Th 24578

Abstract
(Not Verified)

In the present thesis, we discuss cohomology classification of the orbit spaces X/G of free G-actions on some finitistic spaces. As an application, we derive numerical indices of G-spaces X, and get Borsuk-Ulam type results. In the first chapter, we recall some basic notions which are needed in later chapters. In chapter 2, we consider free involutions on a finitistic space X~2 RPm × S3 and compute Volovikov's index of such spaces. We use this numerical index to discuss non-existence of equivariant maps X→ Sn and vice-versa.In Chapter 3, we consider free Zp-action, p>2 a prime, on a space X~p FPm × S3, where F=C or H. More explicitly, we prove parametrized versions of the Borsuk-Ulam type theorems for fibre bundles with fibre X ~p FPm × S3.In chapter 4, we generalize the result of Jaworowski result to free actions of circle group on a finitistic space with the integral cohomology of a lens space. As an application, we get conditions for the non-existence of equivariant maps X → S2k+1 and vice-versa, where X is a finitistic space with an integral or mod 2 cohomology of lens space, and calculate the size of the set of balanced points of maps f:X → Ck. We also establish the parametrized version of the Borsuk-Ulam type theorem for bundles whose fibre is X with mod 2 cohomology lens space. In Chapter 5, we prove that every p-subgroup of finite group G acting freely on spaces of cohomology type Sn ∨ S2n ∨ S3n is either cyclic or a generalized quaternion group. Moreover, it is proved that Z2 is the only group which can act freely on such spaces when n is even. Moreover, we show that if a finite group G acts freely on Sn × S2n, then G can not contain Zp ⊕ Zp, for all odd prime p.

Contents

1. Introduction 2. Preliminaries 3. Free Z_p actions on the product of a projective space and 3-sphere 4. Free circle group actions on cohomology lens spaces 5. Free actions of finite groups on spaces of cohomology type (0,*b*). Bibliography.

16. SINGH (Manoj)
Structure of Shock Waves in Gases under Viscosity and Heat Condition.
Supervisor: Dr. Arvind Patel
Th 24579

Abstract
(Not Verified)

In chapter 1, basic concept and historical developments of shock wave, structure of shock wave, continuum model/kinetic theory, viscosity, heat conduction, basic

equations and boundary conditions and travelling wave solution are discussed. In chapter 2, shock wave structure is investigated in one-dimensional steady flow of a viscous non-ideal gas under temperature dependent viscosity and heat conductivity. For Prandtl number equal to 3/4, the exact velocity, density, pressure, Mach number, change in entropy, viscous stress, heat flux and shock thickness across shock transition zone have been obtained in non-ideal gas. In chapter 3, shock wave structure is studied in one-dimensional steady flow of viscous non-ideal gas under density and temperature dependent viscosity and heat conductivity in term of singularity analysis, isoclines and integral curves. Shock wave thickness decreases with increase in the non-idealness parameter for temperature independent viscosity and heat conductivity but increase for the temperature dependent properties. In chapter 4, travelling wave solution of a Riemann problem and shock structure in an unsteady flow of a perfect gas under viscosity have been investigated. The exact solutions for the velocity, pressure, temperature and change in entropy and shock thickness are obtained. In chapter 5, travelling wave solution of a shock structure in an unsteady one-dimensional flow of a viscous non-ideal gas is obtained between the two uniform boundary states. The variation of flow variables and inverse shock thickness has been computed and validity of continuum model is discussed. In chapter 6, we have solved the system of one-dimensional unsteady gas dynamic equations for adiabatic flow of a perfect gas in all the three symmetry under the variable initial condition by applying the Adomian decomposition method. The variation of flow-variables with position and time is presented which show that there exists a discontinuity or shock wave in the flow field.

Contents

1. Introduction 2. Shock wave structure in a non-ideal gas under constant and variable coefficients of viscosity and heat-conductivity 3. Shock wave structure in a viscous non-ideal gas under heat condition 4. Travelling wave solution of a Riemann problem and shock structure in an unsteady flow of a perfect gas under viscosity 5. Travelling wave solution of shock structure in and unsteady flow of a viscous non-ideal gas 6. Study of a one dimensional unsteady gas dynamic problem by adomian decomposition method. References.

17. TIWARI (Devendra)
Study of Discreteness of Subgroups and Operators on Rank One Spaces.
Supervisor: Dr. M. M. Mishra
Th 24574

Content

1. Summary of the thesis 2. Classical jorgensen's inequality in SL(2,C) 3. Quaternionic jorgensen's inequalities 4. On generalized jorgensen's inequality in SL(2,C) 5. Strictness in the cao-parker inequality 6. Discreteness criterion for subgroups in Sp(n,1) 7. Discrete hermite operator 8. References

18. VASISHT (Radhika)
Variants of Transitivity, Sensitivity and Expansivity in Non-Autonomous Discrete Systems.
Supervisor: Prof. Ruchi Das
Th 24565

Abstract
(Verified)

The present thesis is written in the area of topological dynamical systems. The research work is devoted to the study of stronger forms of transitivity, stronger forms of sensitivity andgeneralizations of expansivity for non-autonomous discrete systems. The organization of the thesis is as follows: Chapter 1 gives a historical background of the research problems studied and preliminaries required for the remaining chapters. Chapter 2 introduces the concepts of F −transitivity and F −mixing using Furstenberg family F, for non-autonomous discrete dynamical systems, both of which are stronger forms of transitivity. We have proved several results for these two variants of transitivity along with some other stronger forms of transitivity. Chapter 3 is devoted to the study of stronger forms of sensitivity for non-autonomous discrete dynamical systems. We have proved that under certain conditions, if the rate of convergence at which φn converges to φ is 'sufficiently fast', then various forms of sensitivity for the non-autonomous system (X,φ1,∞) and the autonomous system (X,φ) coincide. Moreover, we have also studied some stronger forms of sensitivity for the k-th iterate and finitely generated non-autonomous systems. Chapter 4 deals with the study of the dynamics of the hyperspace of a non-autonomous discrete dynamical system. We study the interrelations among various stronger forms of transitivity and sensitivity and the shadowing property for the non-autonomous system (X,φ1,∞)) and its inducedhyperspace (K(X), ¯φ1,∞). In Chapter 5, we have introduced and studied various generalizations of the concept of expansiveness for non-autonomous discrete dynamical systems, namely n-expansiveness, ℵ_0−expansiveness, continuum-wise expansiveness and meagre expansiveness. Finally, interrelation among n-expansiveness, ℵ_0 −expansiveness, continuum-wise expansiveness and meagre-expansiveness is studied.

Content

1. Introduction 2. Stronger forms of transitivity for non-autonomous discrete systems 3. Stronger forms of sensitivity for non-autonomous discrete systems 4. Hyperspace dynamics for non-autonomous discrete systems 5. Generalizations of expansivity for non-autonomous discrete systems. References. Index.

19. YADAV (Priyanka)
Optimality and Duality in Vector Optimization Using Higher-Order Generalized Cone-Convex Functions.
Supervisor: Dr. Sunila Sharma
Th 24577

Abstract
(Verified)

In this thesis, vector optimization problem over cones (VOP) is considered and second and higher-order Karush--Kuhn--Tucker (KKT) optimality conditions and duality theorems are obtained. Optimality conditions for (VOP) with non-convex feasible set are also discussed. The thesis is divided into four chapters as described below. Chapter 1 discusses the basic concepts of Mathematical Programming and literature related to our work. Summary of the thesis has been provided at the end of this chapter. Chapter 2 deals with nonsmooth (VOP) wherein the functions involved are first and second-order directionally differentiable. Second-order KKT type sufficient optimality conditions and second-order duality results are proved using nonsmooth second-order cone-convex functions and its generalizations. Chapter 3 discusses higher-order KKT sufficient optimality conditions and duality results for

both differentiable and nonsmooth (VOP) containing support functions. Using Generalized higher-order cone-convex functions and its weaker notions, higher-order KKT sufficient optimality conditions and higher-order duality results for differentiable (VOP) have been derived. Also, a unified higher-order dual for the nonsmmoth (VOP) involving support functions has been constructed and duality theorems are established. Chapter 4 is devoted to the vector optimization problem (VOP) with non-convex feasible set. KKT optimality conditions for the differentiable (VOP) are obtained without (generalized) cone-convexity assumption on the constraint function and assuming the strict level set of the objective function to be convex. Further, KKT type sufficient optimality conditions have been deduced for the nonsmooth (VOP) wherein the functions involved are locally Lipschitz, again without imposing any cone-convexity assumption on the constraint function but assuming the objective function to be generalized nonsmooth cone-convex. We have also associated Mond-Weir type duals with both the problems and proved duality results in the modified situation.

Contents

1. Introduction 2. Second-order cone convexity in nonsmooth vector optimization problem 3. Higher-order cone-convexity in vector optimization problem 4. Non-convex vector optimization problem. References.

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Supervisor: Dr. Ajay Kumar